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10/788,888

# PATENT SPECIFICATION

(11) 1 562 190

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(21) Application No. 36413/68 (22) Filed 30 July 1968
(31) Convention Application No. 34521
(32) Filed 3 Aug. 1967 in
(33) Fed. Rep. of Germany (DE)
(44) Complete Specification published 5 March 1980
(51) INT CL³ G02B 27/17
(52) Index at acceptance G2J B7W

(19) THE PATENT OFFICE LONDON

## (54) DEVICE FOR SCANNING IR PICTURES

(71) We, ELTRO GMBH & CO., GESELLSCHAFT FUR STRAHLUNGS-TECHNIK, a German Kommanditgesellschaft, of Schlosswolfsbrunnenweg 33—35, Heidelberg, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a device for scanning infrared images, particularly thermal images, using a row of receiving elements, using the method according to co-pending application No.27812/68 (Serial No. 1,560,682). This method has the aim of keeping the picture sequence frequency as low as possible, with a view to a smaller bandwidth and the partly large time constants of the receiving elements.

It is known to scan IR pictures by means of a row of receiving elements disposed one below another, wherein the picture is guided by the scanning movement of an optical/mechanical system past the row of receiving elements, and a multi-line picture is produced according to the number of receiving elements. When a four-sided prism is used, a row of receivers may be scanned four times per revolution of the prism in this manner. However, this arrangement requires a receiving element for each line to be scanned, and if a usable picture is to be obtained, a large number of separate receiving elements is required.

It is an object of this invention to provide a scanning device in which fewer receiving elements can be used without substantial reduction of the picture size or quality.

According to this invention there is provided a device for scanning infrared images, having receiving elements arranged in a row, wherein each receiving element is used for scanning several lines successively and the partial images scanned by the individual receiving elements are combined to form a whole image, characterized by a rotating prism having its axis of rotation parallel to the row of receiving elements and side faces inclined at different angles to the axis.

The invention makes is possible to scan, instead of one line as hitherto, several lines during one revolution, thus reducing the numbers of receiving elements under otherwise like conditions.

Preferably the side faces of the prism are so inclined to the axes of rotation that, during transition from one side face to the next, different lines are scanned, whereby over a full revolution all lines associated with a receiving element are scanned.

In using a scanning method in which two lines are each scanned twice per revolution, a four-sided prism is preferably used in which two opposite side faces are inclined to the axis of rotation at the same angle, but in opposite directions, the faces normal to the axis of rotation being square.

If two opposite faces are parallel and inclined to the axis of rotation, four lines are each scanned once per revolution with a four-sided prism.

If three or more than four faces are able to be scanned per revolution of the prism, a prism is used which has more than four, but an even number of side faces, for example, a six-sided prism. In this case, the faces are so formed that two opposite sides are inclined at the same angle, either parallel or in the opposite direction.

The invention will now be described in more detail by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a diagram showing the general arrangement of a rotating scanning prism, viewed perpendicularly to the optical axis and to the axis of rotation;

Figure 2 (a-c) comprises three views of a scanning prism seen in the direction of the axis of rotation;

Figure 3 (a-b) comprises two views of a scanning prism with opposite surfaces inclined towards each other, seen perpendicularly to the optical axis and to the axis of rotation;

Figure 4 shows a grid (partly broken

away) scanned after one rotation of a prism according to Figure 3;

Figure 5 (a-d) comprise four views of a scanning prism with parallel opposite faces, seen perpendicularly to the optical axis and to the axis of rotation; and

Figure 6 shows a grid scanned after one rotation of the prism of Figure 5.

Figure 1 shows purely diagrammatically an input optical system 11.

Scanning is effected in a convergent beam by a prism 12 rotating about an axis 21. The end faces of the prism, perpendicular to the axis of rotation, are shown at 22 and 32. A row of receiving elements 13 is arranged behind the prism. Convergent beams 5, 6 are deflected at the prism input in the directions 15, 16 and in the directions 25, 26, when leaving the prism.

Figure 2 shows three different positions *a*, *b* and *c* of the prism for scanning perpendicularly to the row of receivers. This is a regular prism, i.e. a prism, the end faces of which are squares, with rectangular side faces perpendicular thereto. The points 1, 2 and 3 indicate individual image on scanning points which are successively reached during one revolution of the prism. All these points are located on one line which is thus scanned four times during one prism revolution.

In Figure 3, the side faces 7, 8, 17, 18 (contrary to the embodiment of Figure 2) are not parallel, but form a very acute angle with the axis of rotation 21, such that always two opposite sides 7, and 17, or 8 and 18 are inclined in opposite directions to the axis of rotation.

Since the angles formed by the sides 7, 17 with the axis of rotation 21 are equal, as are also the angles formed by the sides 8, 18 with the axis of rotation 21 the same beam path will result as shown in Figure 3*a*, if the side 7 is on the right and the side 17 on the left, i.e. after the prism has turned through 180°. The same also applies to the sides 8 and 18, in other words, during every revolution of the prism, the same position of the side face to the optical axis, and thus also the same beam path, are repeated every 180°. If the position of the prism shown in Figure 3*a* is designated I, the position 180° therefrom is designated III, the position of Figure 3*b* is designated II, and the position 180° therefrom is designated IV, line 1 is scanned (Figure 4) with the prism in positions I and III and line 2 with the prism in positions II and IV, and one and the same receiving element is energised in all four positions. In the same way, lines 3, 4 and 5, 6 and so on to $n$ and $n+1$, are each scanned by a further receiving element.

Figure 5 also shows a four-sided prism, in which, however, contary to Figure 3, always two opposite sides, 7 and 17 or 8 and 18 are parallel. The sides 7, 17 are inclined to the axis of rotation at an angle 14, and the sides 8, 18 at a different angle 24. The angle 14 is such that, during the transition from the position I (Figure 5*a*) to the position III (Figure 5*c*), that is to say, during a revolution of the prism through 180 degrees, two lines are missed out or "jumped over," i.e. if the position I the *first* line is scanned, in position III the *fourth* line is scanned (see also Figure 6). On the othe hand, the angle 24 is such that the line jumped between position II (Figure 5*b*) and position IV (Figure 5*d*) is only one line. Thus, if the *second* line is scanned in position II, the *third* line will be scanned in the position IV. If now the difference between the angles 14 and 24 is such that also the line jump from position I to position II is one line, there results automatically from position II to position III, and from position III to position IV always a jump of only one line. Thus, the lines 1 to 4 in Figure 6 are scanned in the position indicated by the Roman numerals, i.e. in the sequence 1, 2, 4, 3.

WHAT WE CLAIM IS:—

1. Device for scanning infrared images, having receiving elements arranged in a row, wherein each receiving element is used for scanning several lines successively and the partial images scanned by the individual receiving elements are combined to form a whole image, characterised by a rotating prism having its axis of rotation parallel to the row of receiving elements and side faces inclined at different angles to the axis.

2. Device according to claim 1, wherein the side faces are inclined to the axis so that during transition from one side face to the next side face, different lines are scanned, and so that during a full revolution of the prism all lines associated with one receiving element are scanned.

3. Device according to claim 1 and claim 2, wherein two opposite side faces are inclined to the axis at the same angle but in opposite directions.

4. Device according to claim 1 or claim 2 wherein two opposite side faces are parallel and inclined to the axis of rotation.

5. Device for scanning infrared images substantially as herein described, with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1562190 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

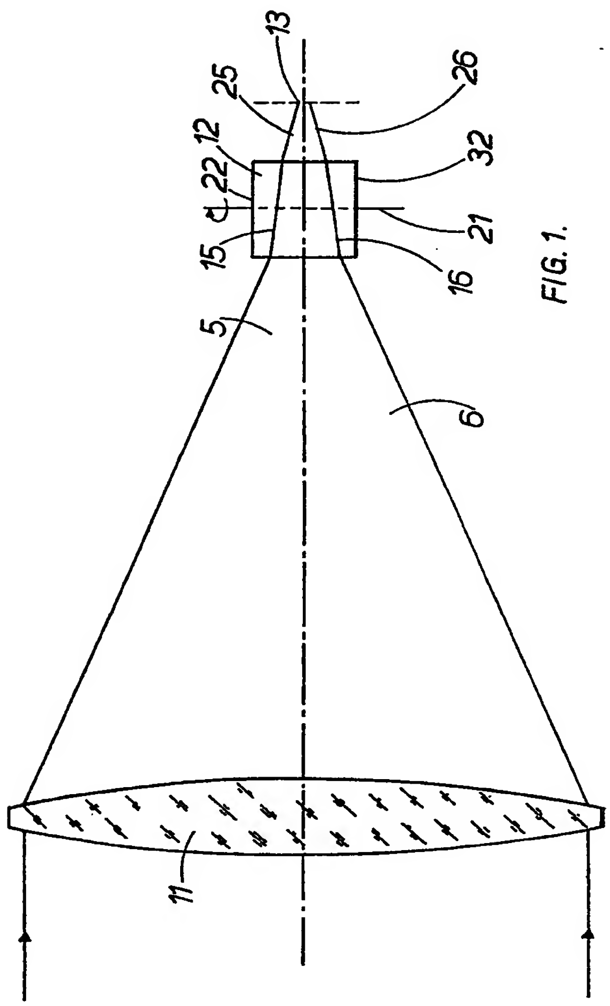


FIG. 1.

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Sheet 2

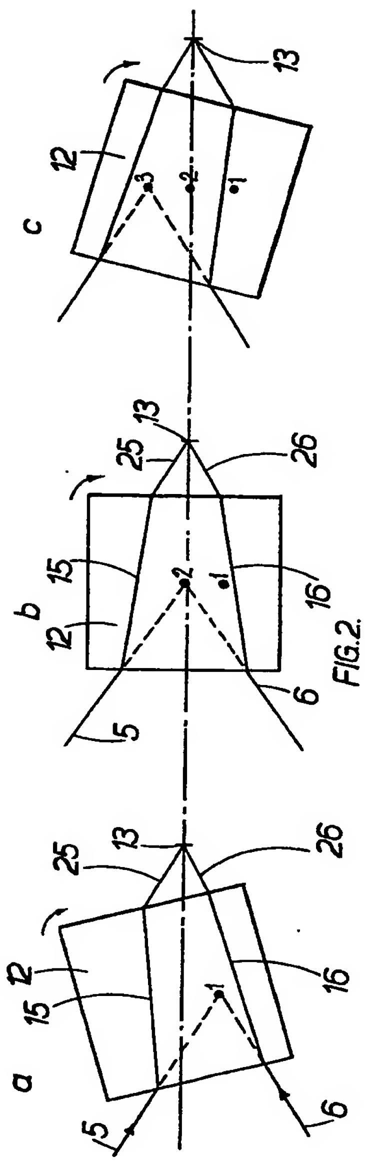

FIG.2.

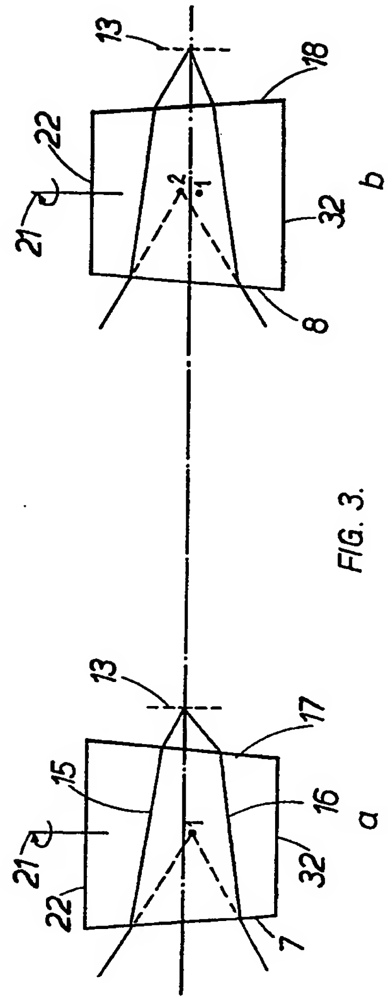

FIG. 3.

1562190 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

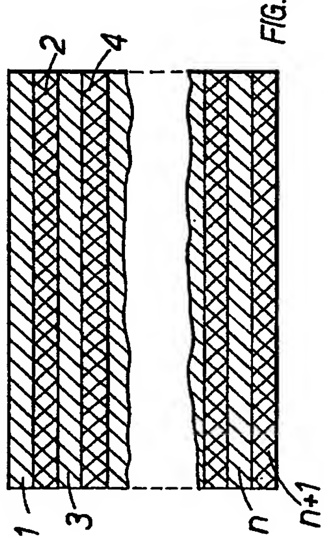

FIG.4.

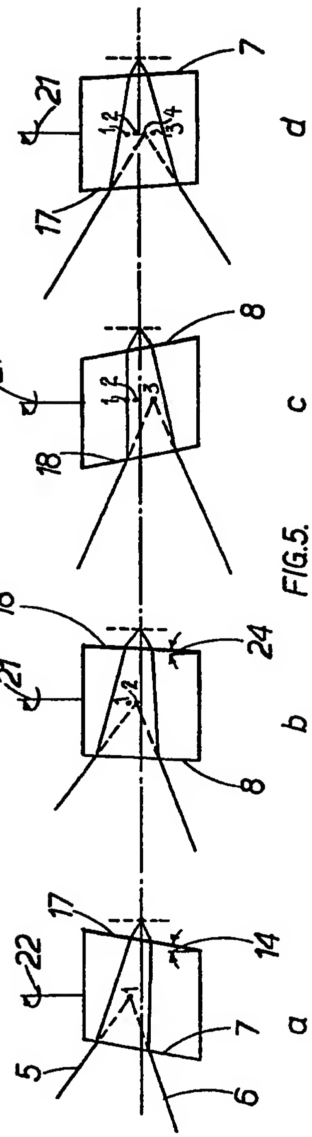

FIG.5.

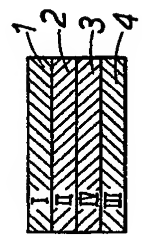

FIG.6.